Engineered Low-Density Polymer WBM Saves Rig Time and Casing String in High-Temperature Well

UMM SHAIF FIELD, UAE

DEPLETED ZONES CAUSE MAJOR LOSSES, STUCK PIPE

An operator in the United Arab Emirates (UAE) planned to drill through naturally fractured depleted zones that had caused lost circulation and differential sticking on offset wells. Maintaining an exceptionally low mud weight (8.5 to 8.7 lb/gal) was essential. A 48-hour logging program to evaluate new, deeper formations was also planned. The drilling fluid needed to remain stable during this operation at a downhole temperature of 300°F (150°C).

The specified high-pressure/high-temperature (HP/HT) fluid loss value was < 14 ml/30 min, at 300°F (150°C).

Data from offset wells showed an average of three days lost to remediating losses and stuck-pipe issues. Pumping a variety of lost circulation materials (LCMs) in pill form had not solved the problem, and, in some cases, calcium carbonate LCM pills actually plugged the drillstring. The formations also had moderate levels of hydrogen sulfide (H₂S) and carbon dioxide (CO₂).

CUSTOMIZED WBM DELIVERS LOW DENSITY AND HIGH-TEMP FILTRATE CONTROL

The Baroid team engineered a fit-for-purpose water-based mud (WBM) system that combined high-temperature polymer chemistry with a lightweight additive that would help meet the fluid loss specification and keep mud densities in an acceptable range.

A total of 23 formulations were tested in the laboratory. The conventional weighted systems could deliver an HP/HT fluid loss of < 14 ml/30 min, but when bridging agents were omitted to achieve the density targets, the HP/HT fluid loss rose to > 25 ml/30 min.

Replacing weight material with a lightening agent enabled Baroid to formulate a fluid that included the required bridging agents and polymer chemistry, in a mud weight range that was previously impossible to achieve without sacrificing performance. In addition to the regular procedures to qualify a drilling fluid prior to field use, a thorough non-standard testing regime was developed and performed to establish whether the lightweight additive was sufficiently rigid to withstand the expected downhole conditions.

To ensure that the lightweight material could be efficiently mixed offshore, the technical team conducted yard tests that simulated the rig’s mixing system. They also assessed the safety and environmental impacts that might arise from the use of large quantities of a product that was relatively unfamiliar.

Baroid DFG™ hydraulics modeling software was used to plan the well and predict equivalent circulating density (ECD) under dynamic conditions to help minimize overbalance. When deploying the fluid at the rigsite, the field engineers used DFG software to make real-time adjustments that would ensure that downhole pressures did not exceed expected values.
The operator was able to gather all exploration data from the deeper formations, while maintaining a well that was converted back to production from shallower targets.

**OPERATOR LOGS DEEP FORMATIONS, AND WELL RESUMES SHALLOW PRODUCTION**

The customized WBM provided good hole cleaning while delivering an ECD of 9.5 ppg or less. Compared to offset wells, this system allowed the operator to save a casing string, avoid lost circulation, run the logging program, and then resume production in the upper zones of the well.

The system eliminated three days of remediation needed on offset wells, and consumed whole mud volume was reduced by approximately 1,500 bbl. This resulted in a combined savings of USD 678,000.

Zonal isolation was achieved with a cemented liner covering depleted zones, as well as normally pressured zones, with one string, eliminating the need for a full string of casing as planned in the initial well design.

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